USING OMI NO_2 OBSERVATIONS TO EVALUATE NO_x EMISSION TRENDS OVER CHINA: INFLUENCE OF CHEMISTRY

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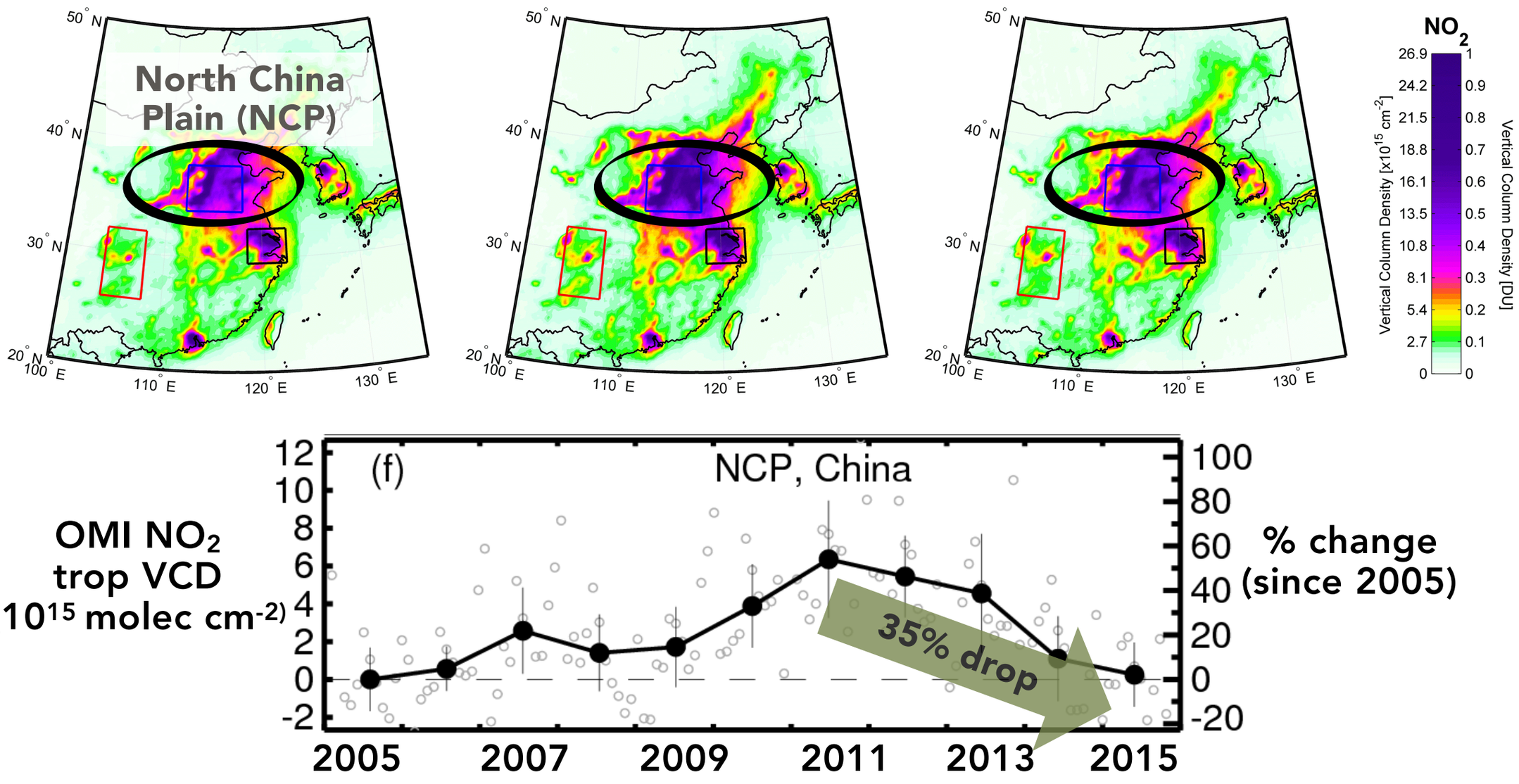
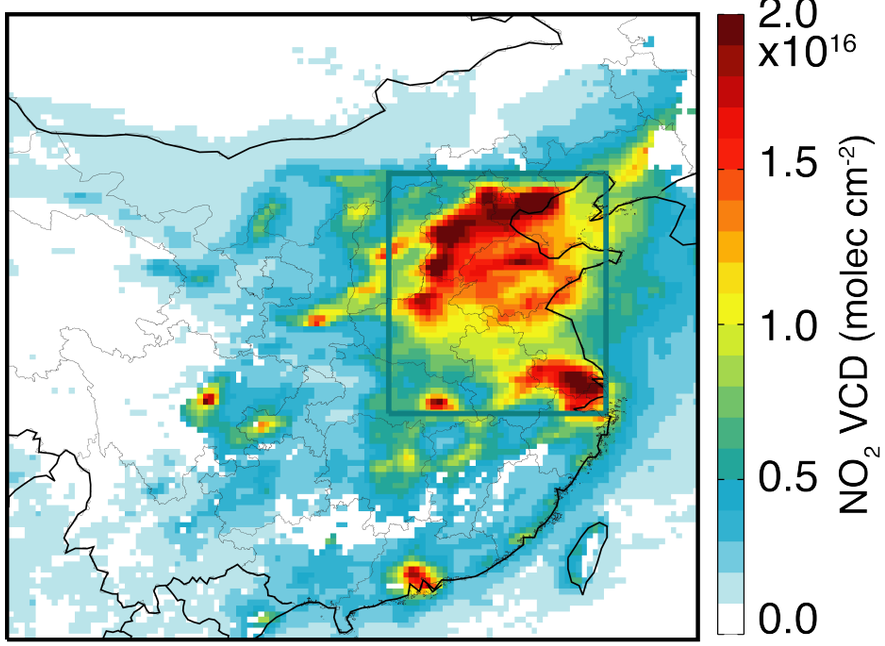
NO_2 VCD over eastern China dropped after 2011 – effect of environmental policies



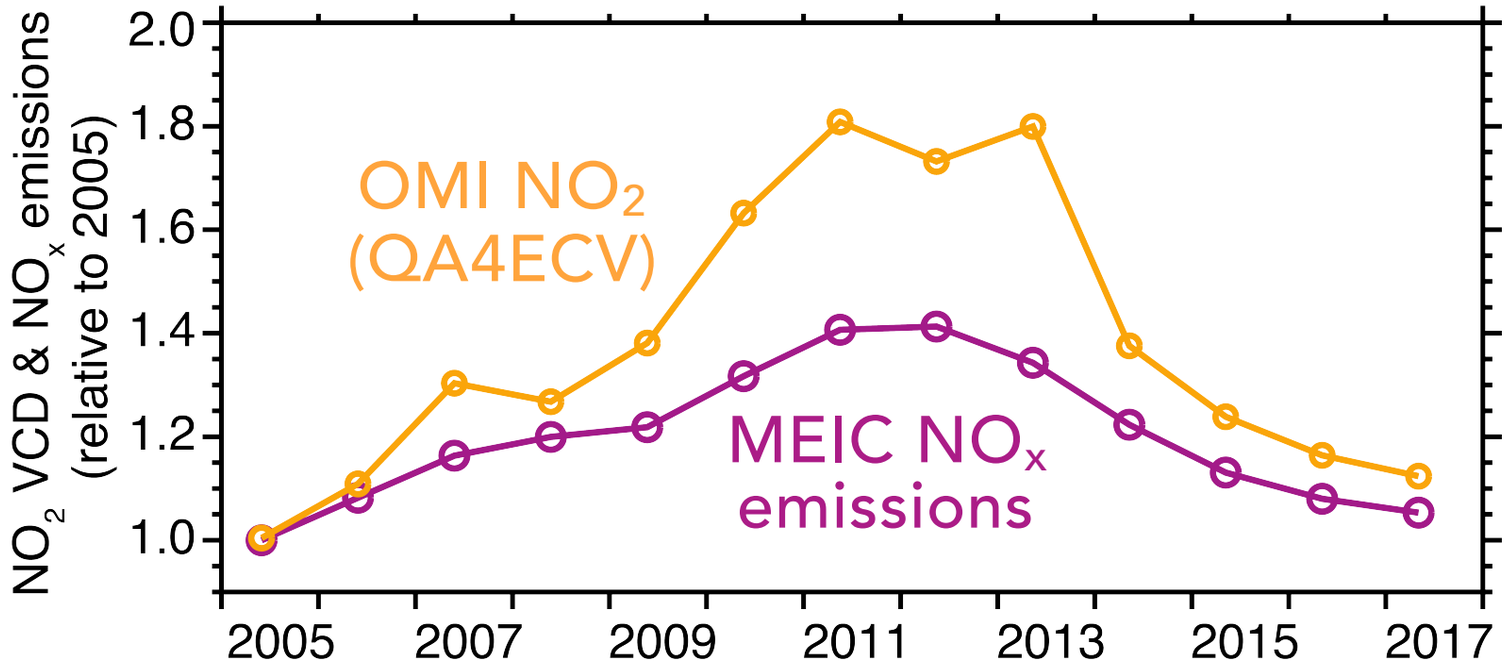
Krotkov et al., 2016

But NO_2 VCD trends are steeper than NO_x emissions trends

QA4ECV NO_2 VCD (2017)



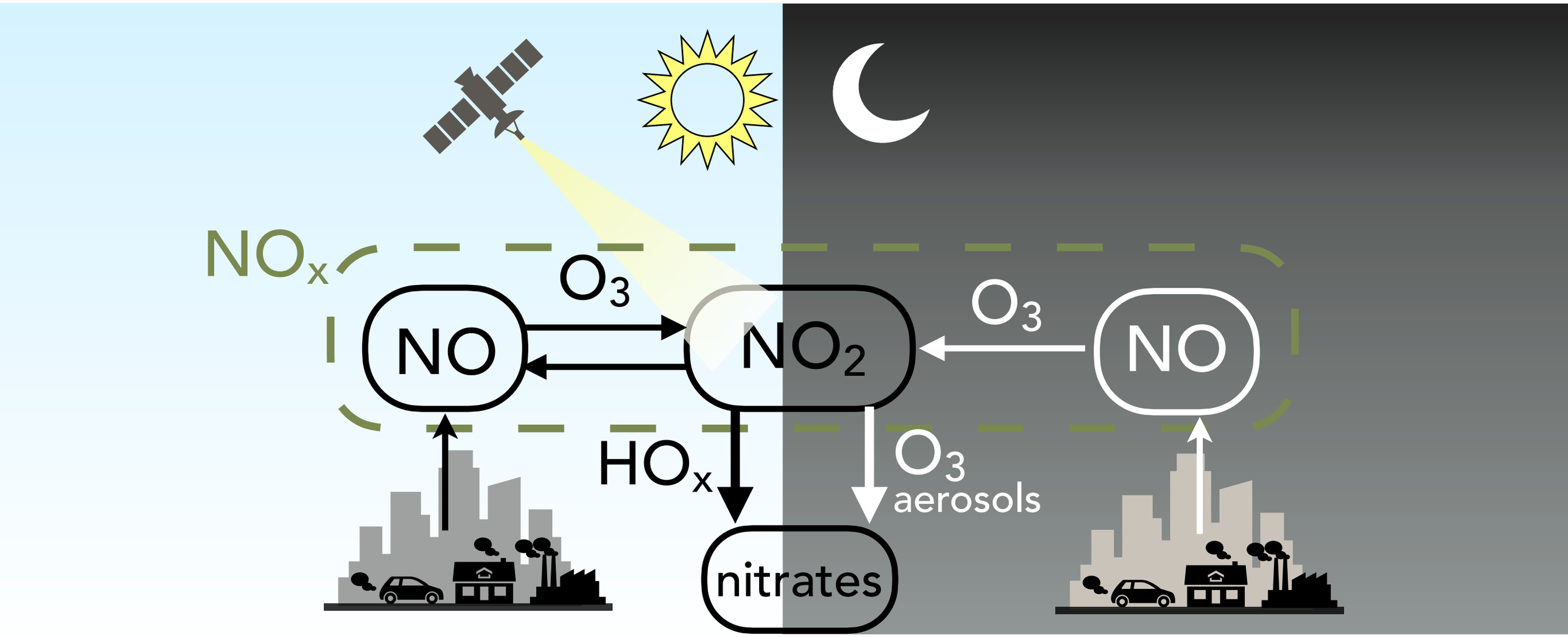
OMI NO_2 VCDs and NO_x emissions relative to 2005



QA4ECV retrieval: Boersma et al., 2018
MEIC emissions: Zheng et al., 2018

Why do NO_2 VCD and NO_x emission trends differ?

NO_2 concentrations depend on NO_x emissions and *chemistry*



NO_x chemistry differs between day and night, and from summer to winter

HO_x and O_3 levels partly depend on NO_x, making chemistry nonlinear

NO_2 concentrations depend on NO_x emissions and *chemistry*

HOW HAS NO_x LIFETIME CHANGED WITH CHANGING EMISSIONS?

GEOS-Chem

+

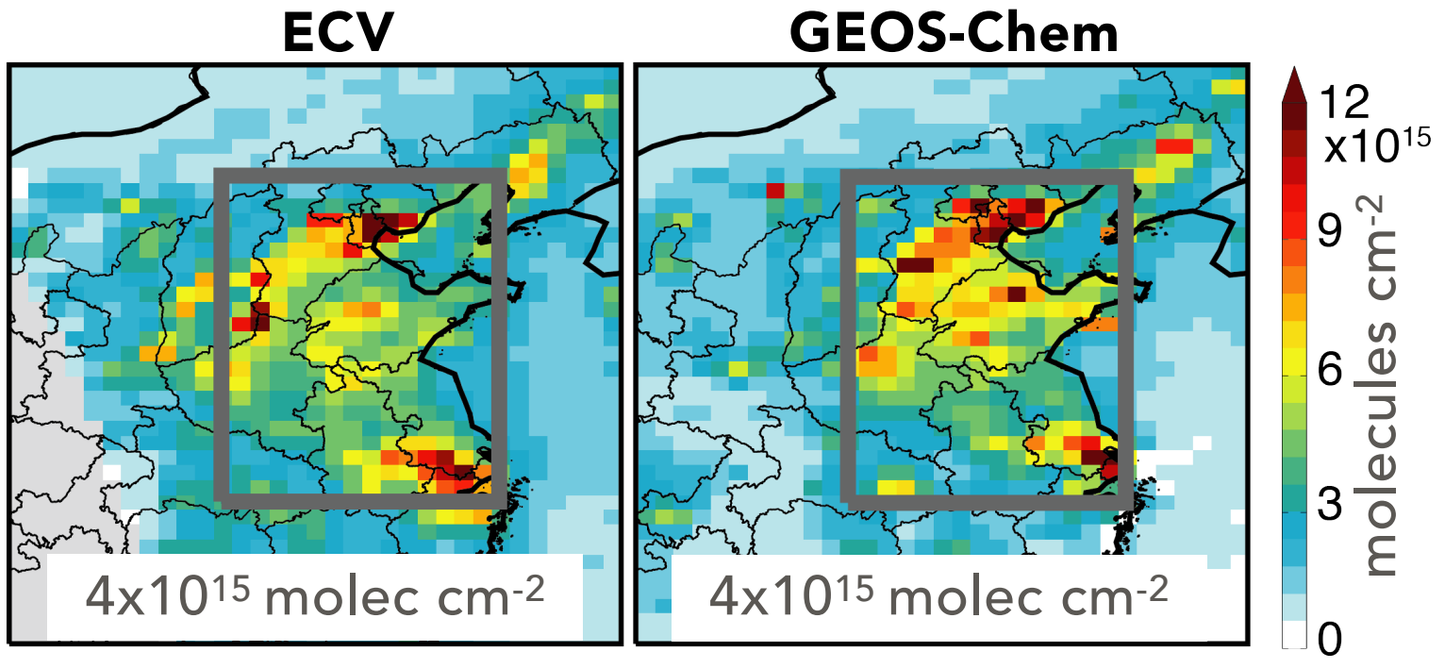
MEIC emissions

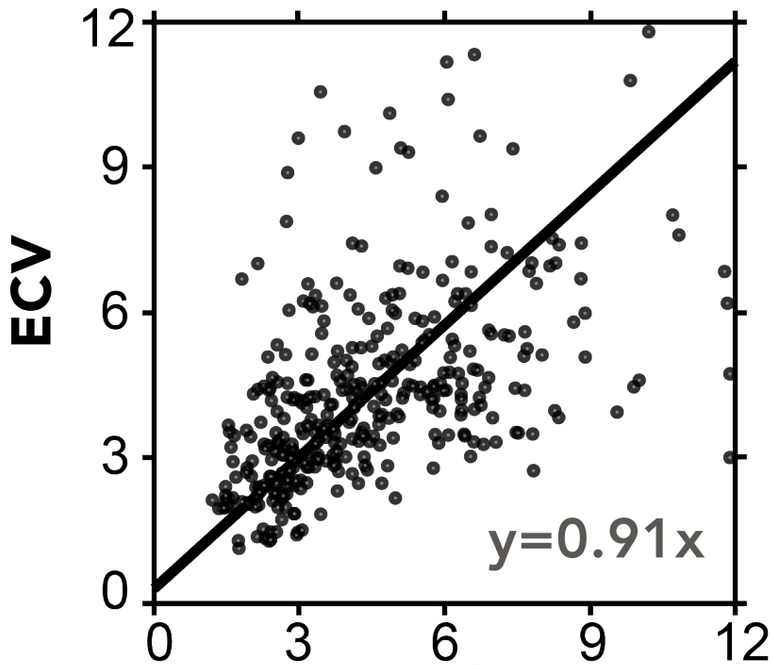
NO_x chemistry differs between day and night, and from summer to winter

HO_x and O_3 levels partly depend on NO_x making chemistry nonlinear

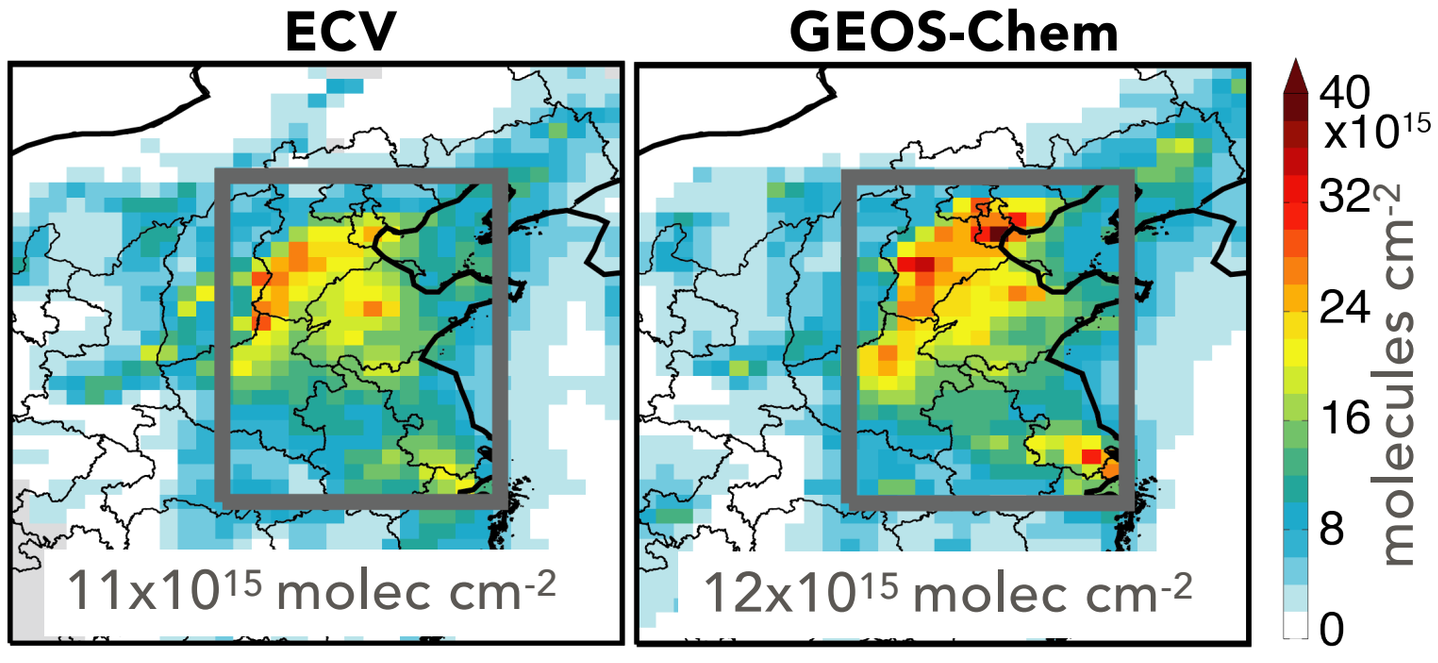
GEOS-Chem NO_2 columns consistent with QA4ECV

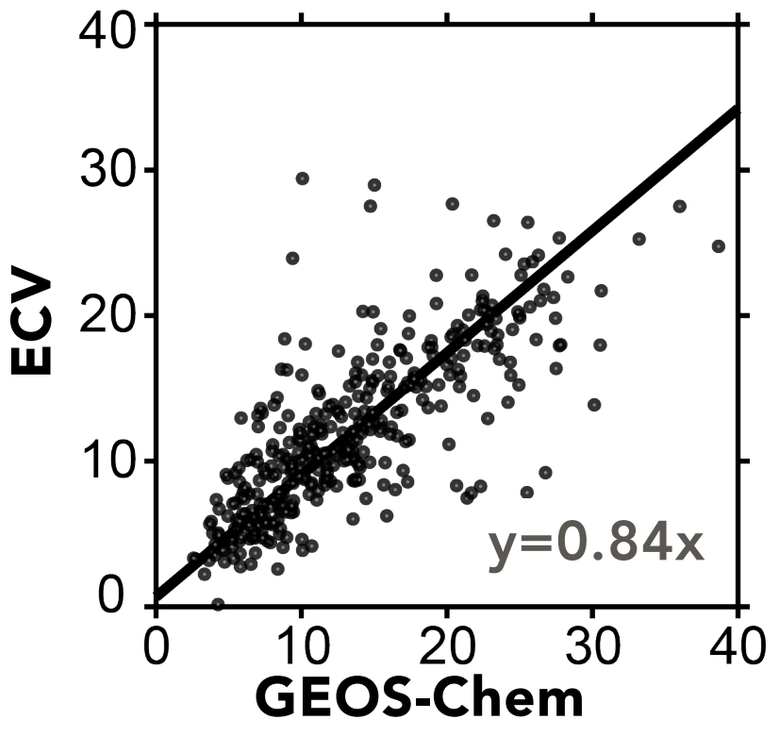
JJA 2017





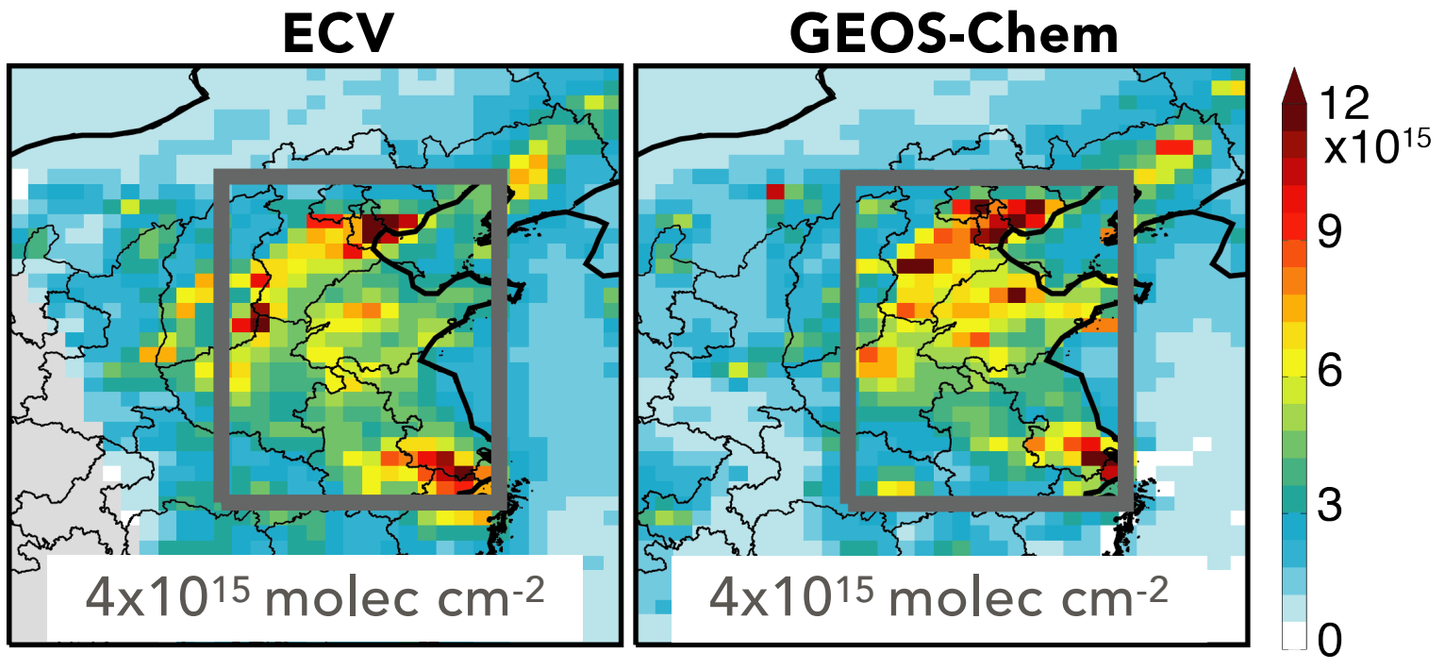
DJF 2016/17



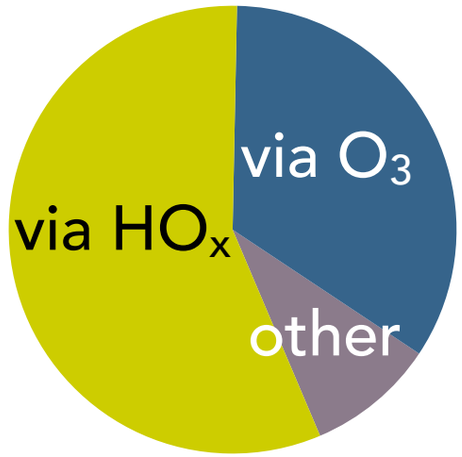


GEOS-Chem NO_x lifetime in DJF 3x longer than in JJA

JJA 2017

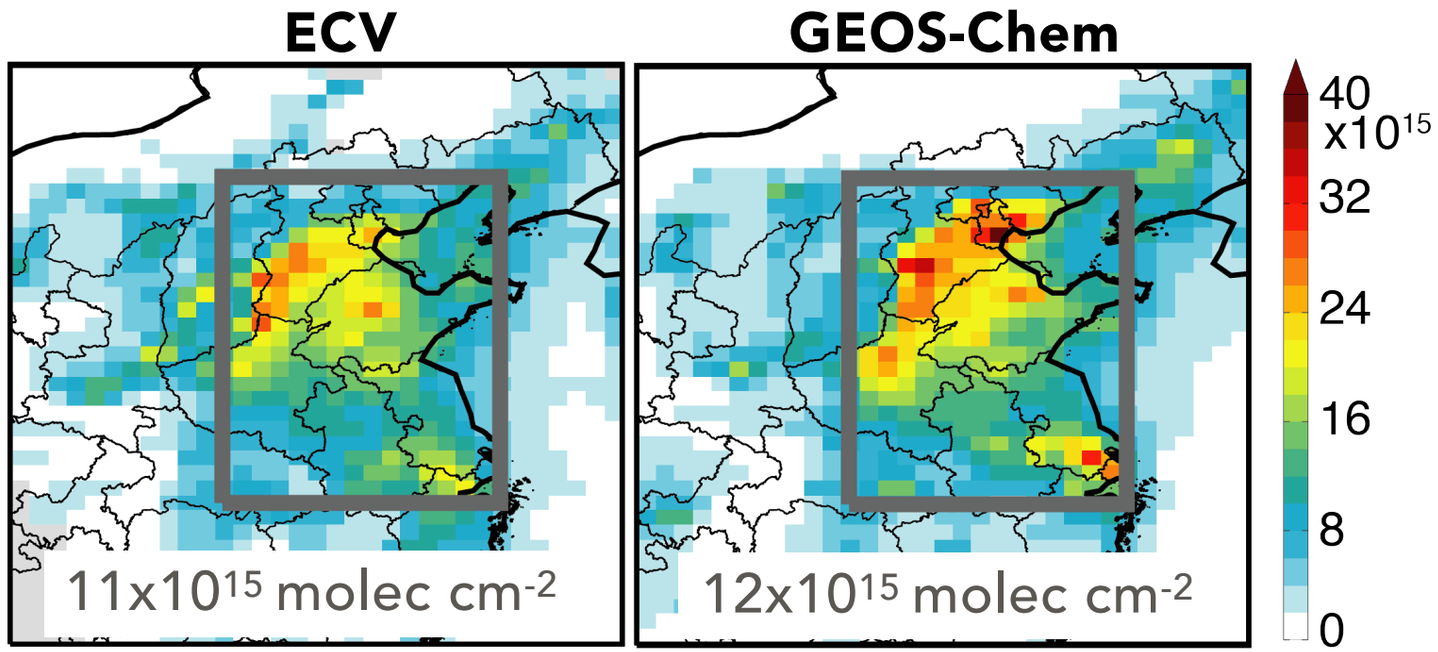


lifetime=6hr



NO_x loss pathways

DJF 2016/17



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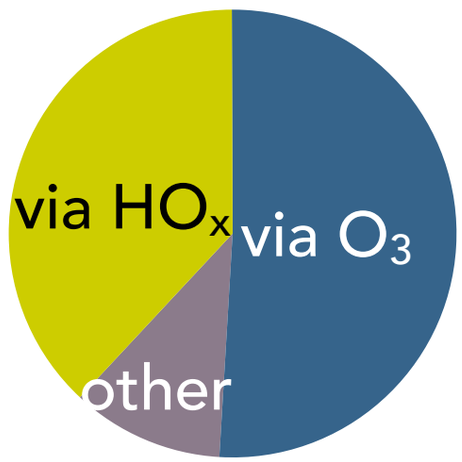
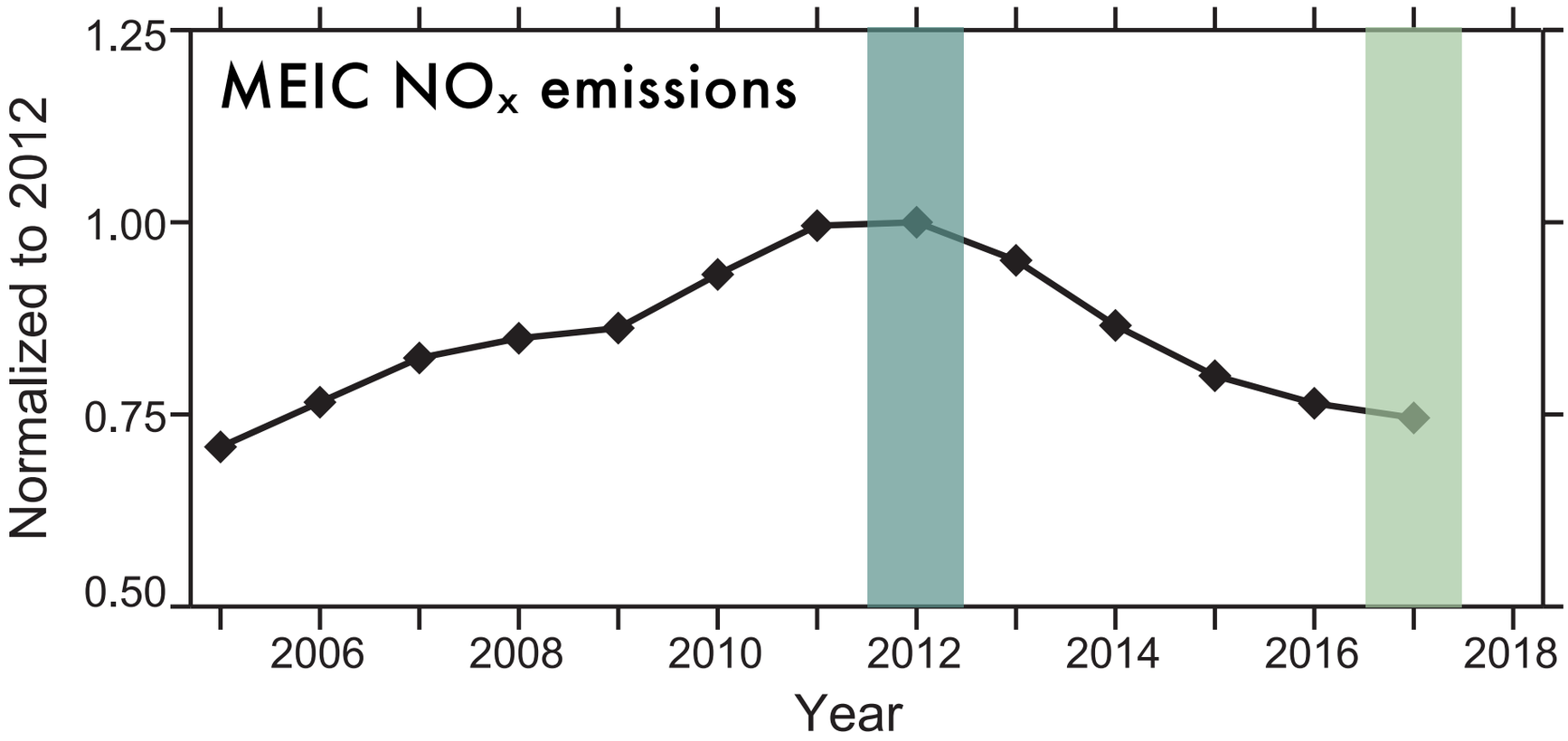
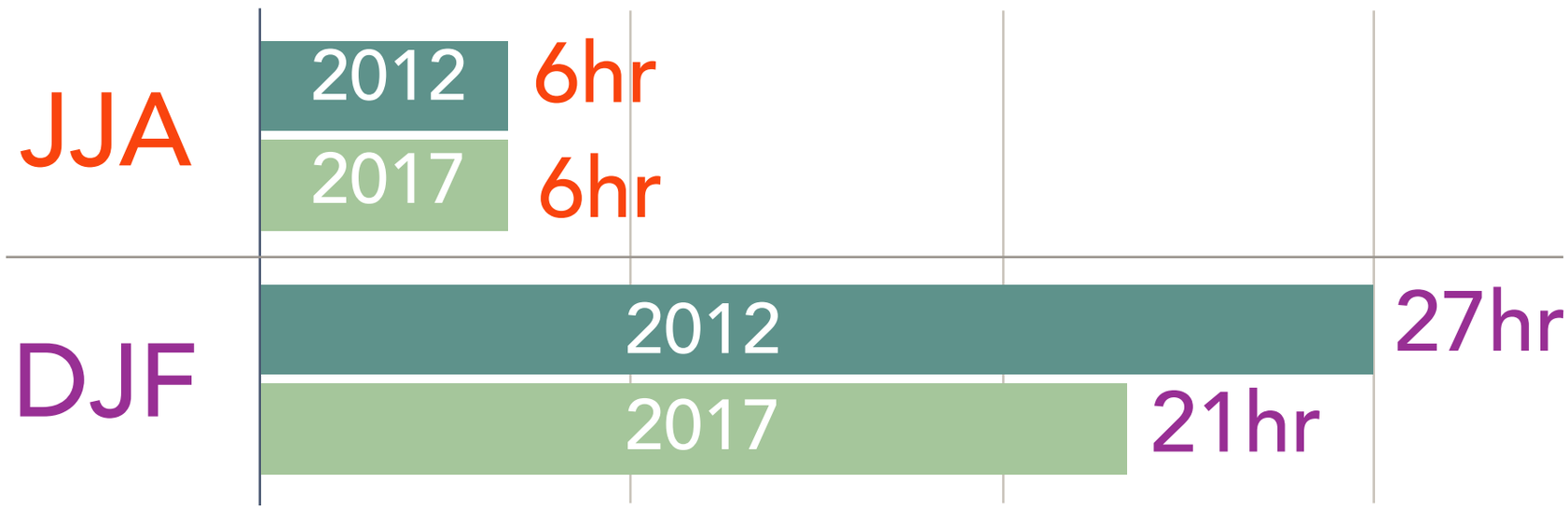


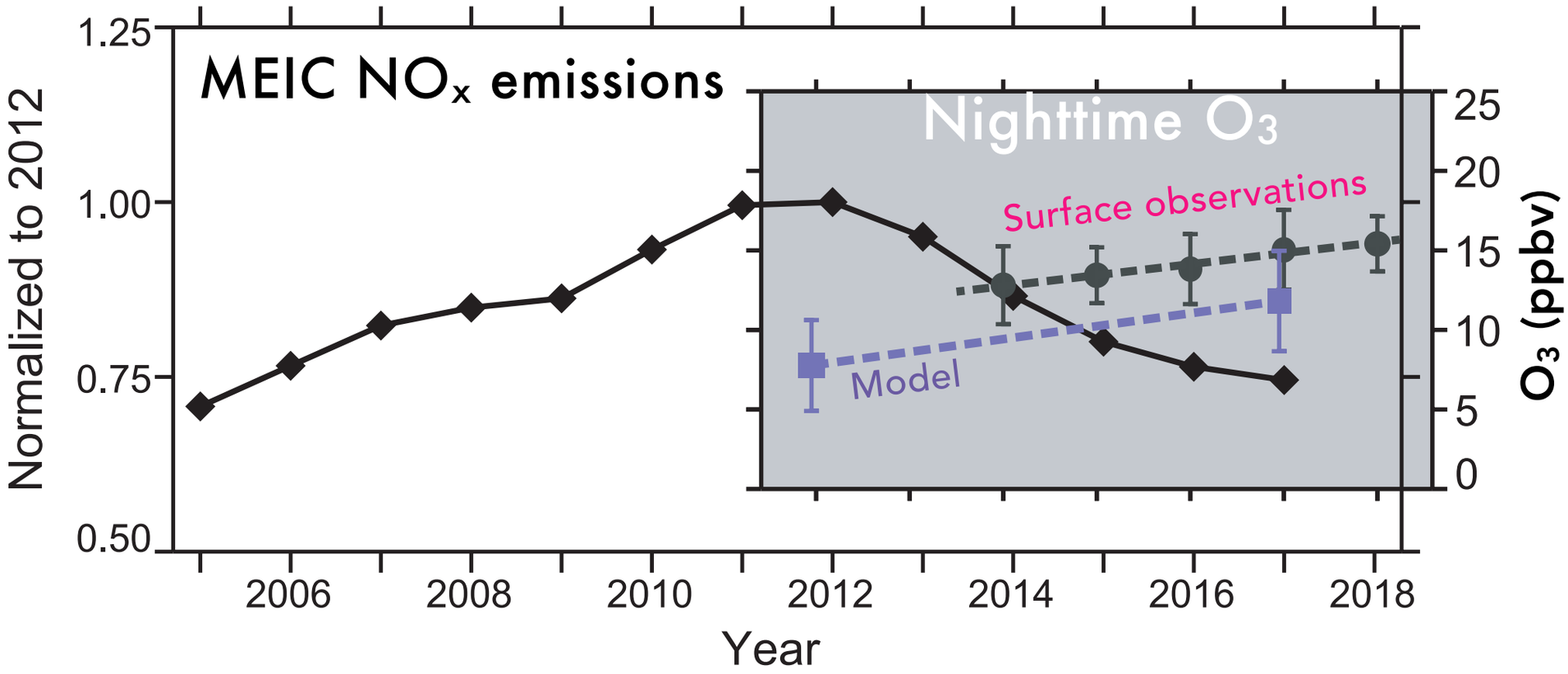
DJF NO_x lifetime shortens at lower NO_x emissions; constant JJA lifetime



GEOS-Chem NO_x lifetime

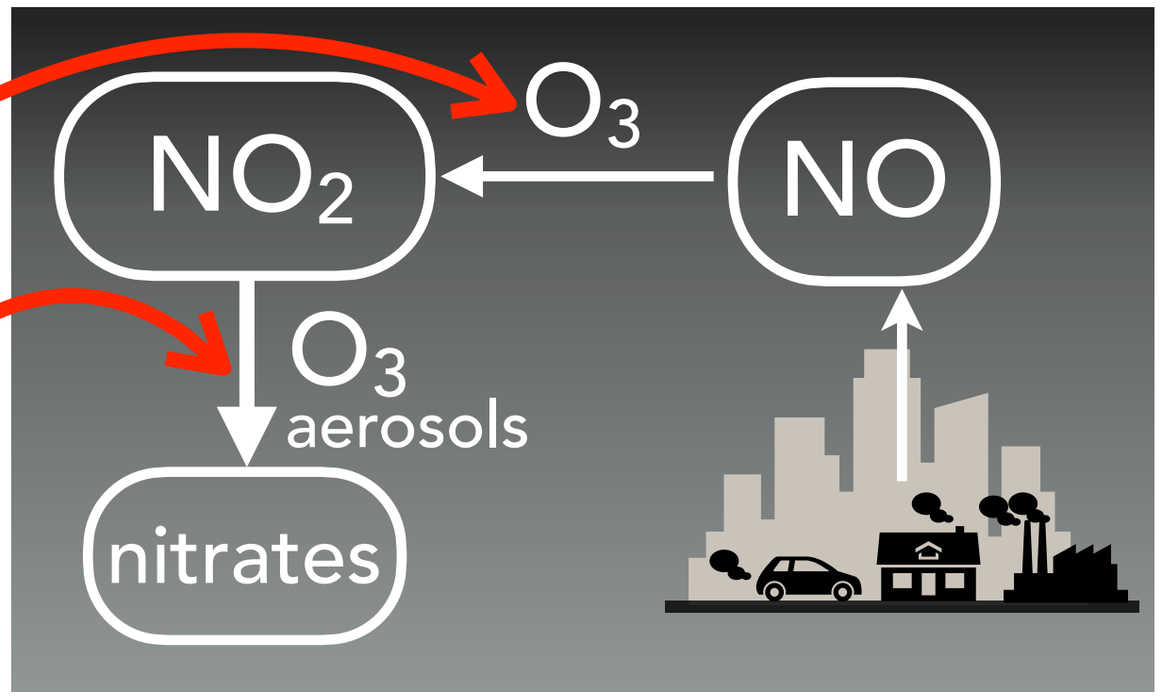


Nighttime O_3 increases at lower NO_x emissions, shortens DJF NO_x lifetime

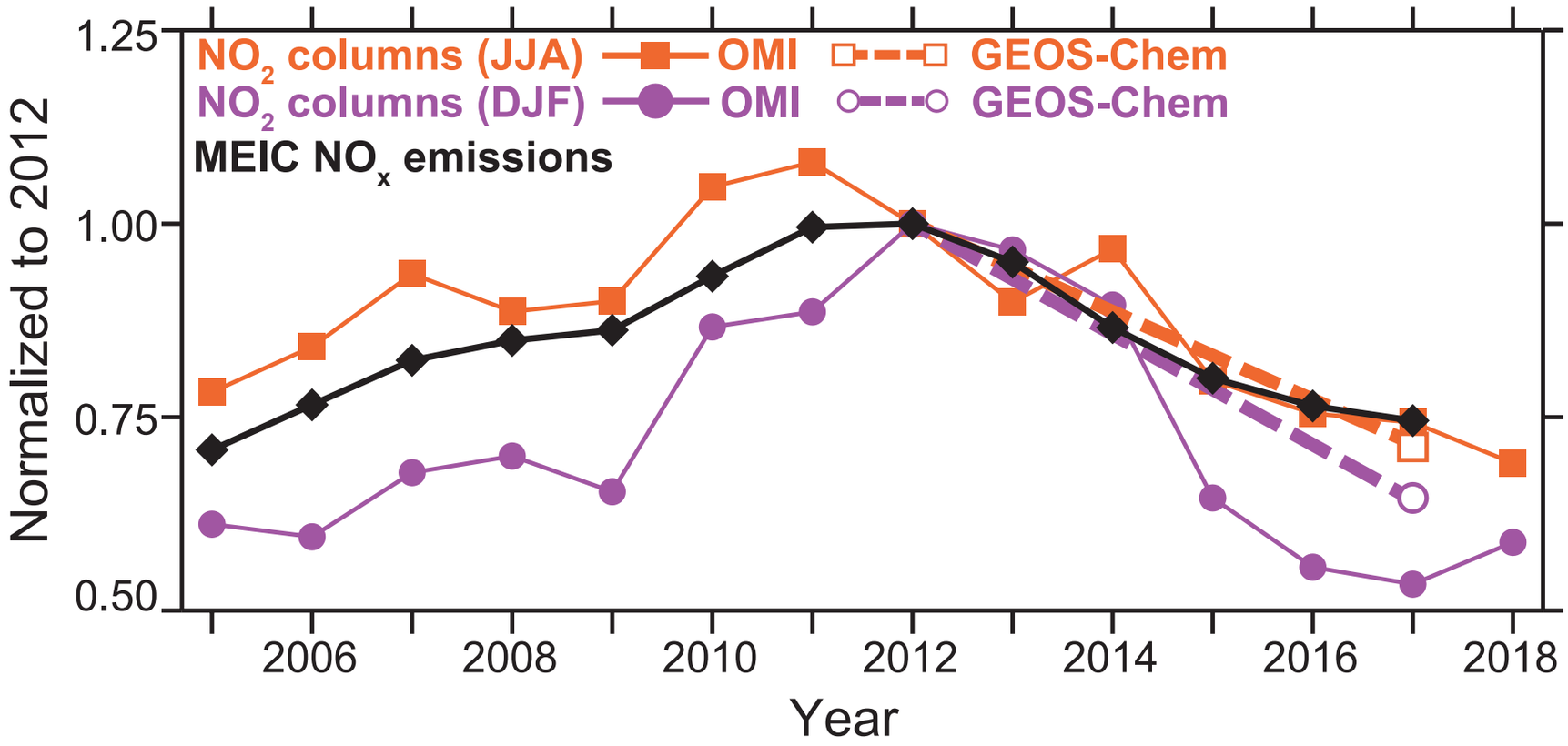


At low NO emissions, less O_3 consumed

And, more O_3 available



JJA NO_2 trends confirm MEIC NO_x emissions trends; DJF NO_2 decreases faster than emissions



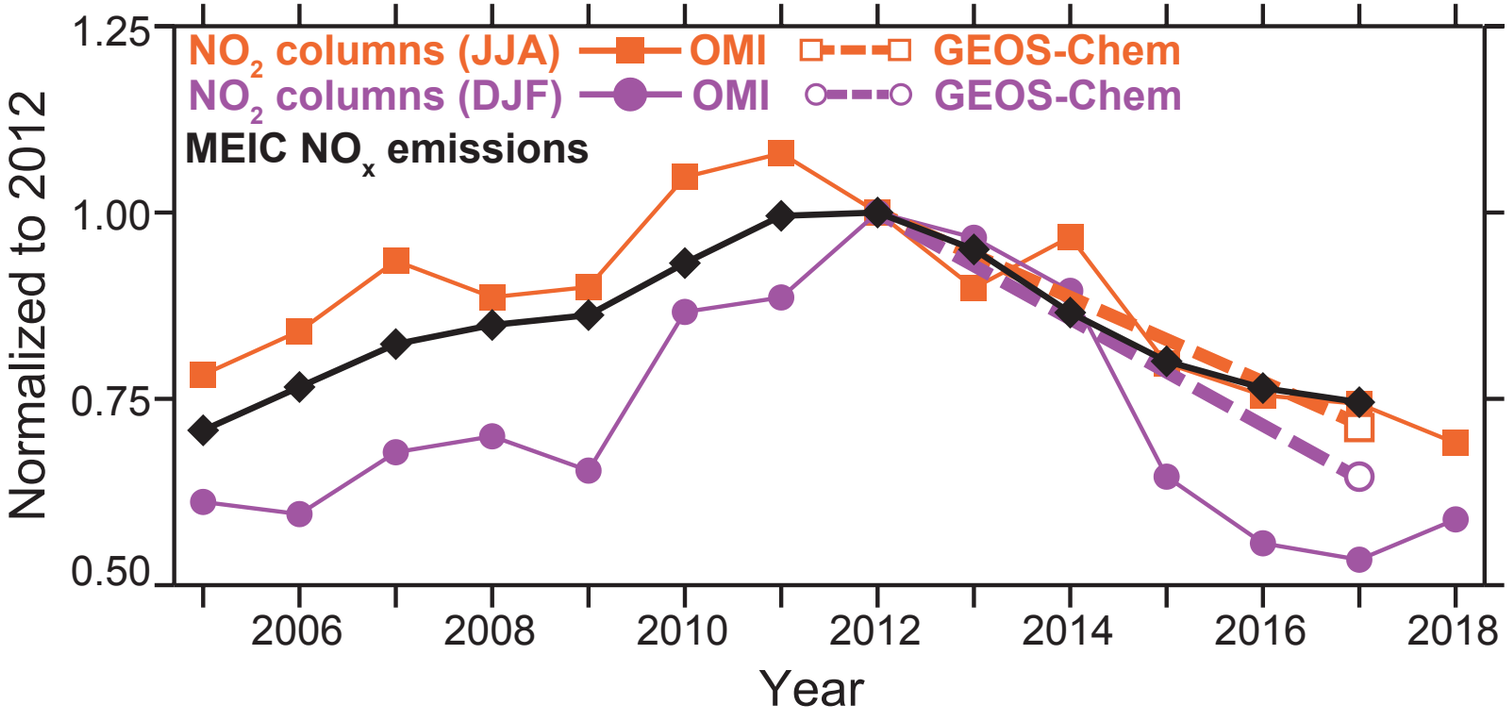
Summer and winter OMI NO_2 trends differ

Summer OMI NO_2 trends consistent with MEIC

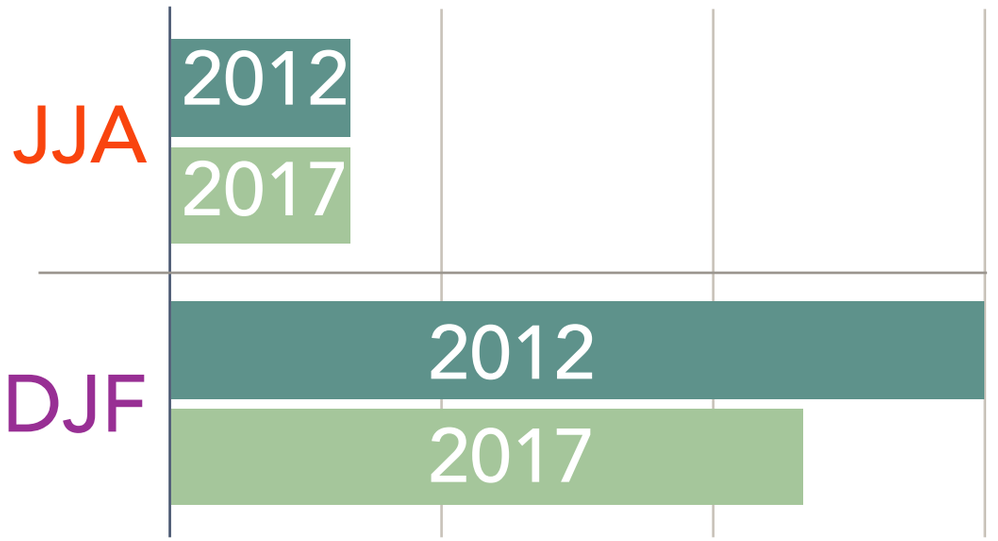
Winter OMI NO_2 trends affected by NO_x lifetime changes

CONCLUSION

NO_2 trends



NO_x lifetime



JJA: NO_2 columns respond linearly to NO_x emissions; OMI NO_2 observations verify MEIC inventory

DJF: NO_2 columns change faster than NO_x emissions because of change in NO_x lifetime